Docket No.: 1509-429 **PATENT**

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of :
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MARQUARDT, Traugott :
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New U.S. Patent Application :
:
Filed: July 30, 2003 :

For: UNDERFLOOR CABLE JUNCTION UNIT AND COMPUTER CENTER EQUIPPED WITH SUCH JUNCTION UNITS

CLAIM OF PRIORITY AND TRANSMITTAL OF CERTIFIED PRIORITY DOCUMENT

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Sir:

In accordance with the provisions of 35 U.S.C. 119, Applicant hereby claims the priority of British Patent Application No. 0217784.8, filed July 31, 2002 in the present application. The certified copy is submitted herewith.

Respectfully submitted,

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Date: July 30, 2003

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1. Your reference

200206985-1 GB

0217784.8

2. Patent application number
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31 JUL 2002

3. Full name, address and postcode of the or of each applicant *(underline all surnames)*

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Patents ADP number *(if you know it)*

Delaware, USA

If the applicant is a corporate body, give the country/state of its incorporation

4. Title of the invention

Underfloor Cable Junction Unit And Computer Center Equipped With Such Junction Units

5. Name of your agent *(if you have one)*

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"Address for service" in the United Kingdom to which all correspondence should be sent *(including the postcode)*

Patents ADP number *(if you know it)*

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Country	Priority application number *(if you know it)*	Date of filing *(day / month / year)*

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Number of earlier application	Date of filing *(day / month / year)*

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11. I/We request the grant of a patent on the basis of this application.

Signature Date

Bruce Graeme Roland Jones 31 July 2002

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UNDERFLOOR CABLE JUNCTION UNIT AND COMPUTER CENTER EQUIPPED WITH SUCH JUNCTION UNITS

FIELD OF THE INVENTION

The present invention relates generally to the provision of data cable connections for computers in a computer center, and more particularly to an underfloor cable junction unit as well as a computer center equipped with such junction units.

BACKGROUND OF THE INVENTION

A raised-floor system is used where it is desirable to maintain ready access below the floor surface to cables, wiring, etc. Such access floor systems are used extensively in computer and control rooms. They have a discrete modular structure, made up of module floor panels which are supported above a base floor by a plurality of upright support columns. Raised-floor systems for computer rooms are, for example, disclosed in US 5,467,609 A and US 6,370,831 B1.

Normally, computers produce a considerable amount of heat, so that computer rooms have to be air-conditioned. The volume between the base floor and the raised floor of a raised-floor system can be used as a cooling air supply duct. Typically, the cooling air enters this volume at one side of the computer room and leaves the volume upwardly through floor panels with cooling air outlets distributed over the computer room (see, for example, JP 2002061911 A).

Usually, computers have to be connected to active network elements, such as routers and switches, with data transmission cables, in the form of copper cables or optical fiber cables. These data cables run below the raised floor so as to keep the surface of the raised floor free of obstacles in order to provide the operators free access to the computer equipment. An example of a raised-floor system with underfloor cable trays is disclosed in US 2002/0003194 A1.

Cabling a computer room uniquely for a particular computer configuration would be very inflexible. For example, if in a certain part of the computer room existing computers are replaced by computers requiring a different type of data cable or having a higher port density, existing data cables would have to be replaced (which is hardly possible) or additional data cables would have to be laid. Therefore, to enable a computer room to be used in a flexible way, computer rooms are usually equipped from the outset with a universal data cabling. For example, such a universal cabling includes as many copper cables and optical monomode and multimode fiber cables as required for all expected future computer configurations. The cables end at cable junction units which are distributed throughout the computer room. These data cables and their respective junction units are permanently installed and are not changed, even when the computer configuration is changed. The ports of each computer are connected to one or more nearby junction units by means of (normally flexible) patch cables. Only the patch cable cabling is changed when the computer configuration changes.

In raised-floor systems, data cable junction units are usually disposed below the surface of the raised floor. Underfloor junction boxes for use in general office areas are, for example, described in US 5,673,522 A and JP 10028313 A. A prior art underfloor cable junction unit used in computer room installations is shown in Fig. 8 which is a perspective view of a part of a computer room with a raised-floor system in which the floor panels are shown to be transparent. On a base floor 1, floor columns 2 support floor panels 3 which together form a raised floor 4. The raised-floor system is a modular system in which the floor panels 3 are typically in the form of squares, for example with the dimension of 60 cm x 60 cm which rest on a square frame which in turn rests on the floor columns 2 arranged at the square corners. The height of the raised floor is typically 50 cm to 70 cm, but there are also installations of only about 30 cm. Computers 5 (only two of them are shown in Fig. 8) are placed on the raised floor 4.

Whereas the basic type of floor panel 3 has a completely closed surface, there are special floor panels 3a with cooling air outlets 6 and floor panels 3b with a cable aperture 7. Cooling air 8 flows in the volume under the raised floor 4 in a

certain direction (from right to left in Fig. 8), and at each floor panel 3a some of the cooling air is branched off upwardly, flows through the cooling air outlets 6 and is partly sucked in by the nearby computers 5.

The room under the raised floor 4 also accommodates the cabling of the computer room. For example, in Fig. 8 bunches 9 of data cables run from a data communication room (not shown in Fig. 8) on the left-hand side of Fig. 8 on the base floor 1 from the left to the right in Fig. 8 (only one cable bunch 9 is shown in Fig. 8). The cable bunches comprise individual data cables 10 or bundles 12 of data cables which run in trough-like cable trays (not shown in Fig. 8) which define a cable route and thereby form the cable bunches 9. A plurality of underfloor cable junction units 11 are arranged throughout the computer room under the raised floor 4, one of which is illustrated in Fig. 8. The cable junction unit 11 is a closed box mounted on a support 13 closely below a floor panel 3 of the raised floor 4. The support 13 is C-shaped, wherein the lower leg 14 of the "C" is fixed to the base floor 1 and the junction unit 11 is mounted on the upper leg 15 of the "C". The cable bunch 9 runs over the lower leg 14. The junction unit 11 has a cable bundle inlet 16 at one of its faces and a row 17 of connectors or ports 18 at either lateral side. In the example of Fig. 8, the junction unit 11 has two rows 17 of eight connectors 18, i.e. sixteen connectors or ports 18 in total. One of the cable bundles 12 branches off from the cable bunch 9 and runs upwardly to the cable bundle inlet 16. Inside the box-shaped junction unit 11, the cable bundle 12 is separated into individual cables 10 which are here connected to the cable connectors 18. If the cables 10 are copper cables, the cable connectors 18 are typically RJ45 connectors. If the cable bundle 9 is an optical bundle cable, the junction unit serves as a splice box, in which, upon installation, the optical bundle cable is separated into individual optical fibers, the ends of which are then manually spliced with the (optical) connectors 18 within the junction unit 11. The optical cable connectors are typically SC or ST connectors.

The cabling described so far, is permanent, i.e. it is not changed when the configuration of computers 5 to be connected is changed. Rather, the part of the cabling which is adaptable to a particular computer configuration is constituted by patch cables 19 with suitable cable connectors 20 and both ends. The (typically

flexible) patch cables 19 connect the connectors 18 with computer ports 21. They run from the junction units 11 below the raised floor 4, pass through the cable aperture 7 next to the computer 5 to be connected, and then run on the raised floor 4 to the computer 5.

Although junction units of the type described in Fig. 8 were considered sufficient in the past, there remains a need to provide an improved underfloor cable junction unit and computer centers equipped with such improved junction units.

SUMMARY OF THE INVENTION

The invention is directed to an underfloor cable junction unit for installation in a raised-floor system. The cable junction unit comprises rows of connectors. These connector rows are arranged on at least two levels, one above the other.

According to another aspect, the invention is directed to a computer center having a raised floor on which computers are arranged. The raised floor is equipped with underfloor cable junction units by which the computers are connected to permanent data cables running under the raised floor. The junction unit comprises rows of connectors which are arranged on at least two levels, one above the other.

Other features are inherent in the underfloor cable junction unit and the computer center disclosed or will become apparent to those skilled in the art from the following detailed description of embodiments and its accompanying drawings.

DESCRIPTION OF THE DRAWINGS

In the accompanying drawings:

Fig. 1 illustrates, in a perspective view, a part of an exemplary computer room with computers arranged on a raised floor and a preferred embodiment of an underfloor cable junction unit;

Fig. 2 shows a more detailed side view of the underfloor cable junction unit of Fig. 1;

Fig. 3 shows a more detailed front view of the underfloor cable junction unit of Fig. 1;

Fig. 4 shows a more detailed top view of the underfloor cable junction unit of Fig. 1;

Fig. 5 shows a cut-out of the front view of Fig. 3, in which a curved cable guide is visible;

Fig. 6 illustrates another embodiment which adjustable height and width;

Fig. 7 illustrates schematically a computer center equipped with underfloor cable junction units as shown in Figs. 1 to 6;

Fig. 8 illustrates, in a perspective view similar to Fig. 1, a part of a computer room with computers arranged on a raised floor and underfloor cable junction units, as used in the prior art.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Fig. 1 illustrates, in a perspective view, a part of an exemplary computer room with computers arranged on a raised floor and a preferred embodiment of an underfloor cable junction. Before proceeding further with the description, however, a few items of the preferred embodiments will be discussed.

Whereas in the above-described prior art underfloor cable junction unit the connectors are arranged at the same horizontal level closely below the floor panel of the raised floor, in the preferred embodiments the connector rows are arranged on at least two levels one above the other. This enables much higher port densities to be achieved (i.e. number of ports per floor module or per square meter), for example a port density higher by a factor 8 to 24. Since the development of server computer technology has led to an ever-increasing number of ports per footprint of a server computer, the port density provided by an underfloor cable junction unit may be the limiting factor for the number of computers with which a given computer room can be equipped. Therefore, the preferred embodiments of the cable junction unit enable a computer room to be equipped with a larger number of computers than was the case with prior art junction units.

In the preferred embodiments, the cable junction unit is designed to be mounted on the base floor on which the raised floor is posted. The preferred cable junction unit is dimensioned such that it can be lowered through a module opening which is present when a module panel of the discrete modular raised-floor system is removed.

The term "underfloor cable junction unit" is meant to include also cable junction units to be mounted in a suspended ceiling (hanging at the solid ceiling, above the suspended ceiling) or at a wall (for example, hanging laterally at the wall of a cable chute).

In the preferred embodiments, the rows of connectors are arranged at two opposing faces of the junction unit. The connectors are arranged such that the permanent cable connections are provided at the inner side of the connectors (i.e. the side facing the inside of the junction unit), and plug-in patch cable connections are provided at the outer side of the connectors (i.e. the outward-facing side of the junction unit), which is, for example, in contrast to the junction unit disclosed in JP 10028313 A, in which the permanent cable connections are provided at the junction unit's outer side. If the floor modules adjacent to the faces with the connector rows are left free (i.e. are not equipped with junction units or the like), the preferred arrangement of the connectors enables a technician to access the connectors easily and establish or change patch cable connections, despite the high port density.

Whereas the prior art junction units illustrated in Fig. 8 are only single-type units (i.e. they provide either copper data cable connectors or optical fiber connectors), in a preferred embodiment the connector rows are at least one of copper data cable connector rows or optical fiber connector rows. In other words, the preferred embodiment can optionally be equipped with data cable connector rows and optical fiber connector rows, thereby realizing a mixed-type junction unit.

In those embodiments of the junction unit equipped with optical fiber connector rows the optical fiber connectors are preferably of a connector type which enables pre-fabricated optical break-out cables, which have pre-installed cable connectors, to be plugged in at the permanent cable connection side of the junction unit connectors, without using a splice box. A preferred optical fiber

connection system is the E2000 system. In this system, both the permanent cables and the patch cables bear the same connectors, and the junction unit connectors are feed-through connectors, into which a permanent cable connector and a patch cable connector are plugged from the two opposite sides. The permanent cable connector can be fixed in the respective junction unit connector by removing a detent clip from the permanent cable connector which is normally to be depressed if a plugged-in connector is to be unplugged. The fact that no splice box is required increases the achievable port density. In addition, the use of pre-fabricated optical break-out cables with pre-installed cable connectors facilitates the installation procedure and enhances the reliability of the optical connections.

The faces of the cable junction unit are defined as those sides which are arranged perpendicularly to the longitudinal direction of the cable bunches running on the base floor, and the lateral sides of the cable junction unit are defined as those sides arranged parallel to this direction. In the prior art junction units illustrated in Fig. 8, the permanent cables or cable bundles leave the cable unit in the center of its face and hang freely which impairs the face's accessibility and increases the risk of the permanent cable being damaged. In the preferred embodiments, the junction unit further comprises at least one horizontal sidebar arranged at the lateral sides of the junction unit. The sidebar is positioned such that it enables permanent cables coming from the inner side of the connector rows to pass above and outwardly of the sidebar downwardly to the base floor. The permanent cables running in this way can be fixed to the sidebar, e.g. by cable ties. This improves the accessibility of the junction unit's faces (on which the connector rows are arranged in the preferred embodiments) and eliminates the risk of the permanently connected cables being damaged.

Similarly, in the prior art junction unit illustrated in Fig. 8, the patch cables leave the junction unit in a manner which impairs the accessibility and, since the patch cables run freely through the volume under the raised floor, makes them prone to damage (e.g. if a floor panel is removed and a heavy object such as a tool is inadvertently dropped into the open floor module, a patch cable connector may easily be broken). The preferred embodiments, however, comprise patch cable guiding elements which are arranged laterally on the faces of the junction

unit or at least a major part of it is open to enable the passage of cooling air through it. Preferably, the lateral sides of the preferred junction unit or at least a major part of them are also open, so as to improve the cooling air circulation.

Since in the preferred embodiments, the junction unit is designed as an upper frame rather than in the form of a closed box, the junction connectors themselves are preferably provided with enclosures. Such connector enclosures do not constrict the cooling air flow (or, at least, do not constrict it as much as the prior art closed-box design), while protecting the interior of the junction unit connectors from dirt etc.

The preferred embodiments of the underfloor cable junction unit are designed in a modular manner, the module parts of which are commercially available standard parts or are at least based on such standard parts. The modularity of the design enables the preferred junction unit to be easily adapted to particular requirements of the data connections to be provided, to particular raised-floor heights, and to a certain extent, to particular dimensions of the floor panel modules. This adaptability has two aspects:

(i) adaptability to particular requirements at the time of the installation of the junction unit; and (ii) adaptability of an already installed junction unit to later changes of requirements. The preferred embodiments are superior over the prior art design illustrated in Fig. 8 in both aspects. Several items regarding adaptability are discussed in more detail below.

In the preferred embodiments, each of the rows of connectors is constituted by a slide-in unit which can be slid into the junction unit at its faces from the outside. Preferably, the slide-in units are standard 19-inch units. For example, each 19-inch unit has 24 linearly arranged RJ45 or E2000 connectors. Preferably, the slide-in units are fixed to the junction unit in a dismountable manner (e.g. by means of screws or clamps) to enable them to be removed, replaced or changed in their position or to enable further slide-in units to be mounted, without dismounting the junction unit. The junction unit of the preferred embodiments has a frame structure. The frame comprises portal-like face parts and sidebars connected to the face parts, such that the face parts are arranged opposite each other. Several mounting positions are provided for the sidebars to

enable them to be mounted at different heights. As mentioned above, the permanent cables coming from the inner side of the connector rows pass above and outwardly of the sidebar downwardly to the base floor. In other words, the permanent cables are bent by about 90° from a horizontal into a vertical orientation. The height of the sidebar relative to the (nearest) connector row defines the minimum bending radius. Therefore, by choosing a certain vertical minimum distance between the sidebar and the (nearest) detector row, a required minimum bending radius can be ensured. Since in the preferred junction unit the cable rows are flexibly mounted at a desired height and connectors for different cable types requiring different minimum bending radii can be flexibly mounted, the fact that several mounting positions are provided for the sidebars provides full modular flexibility while enabling the junction unit to be set-up in a way which ensures the minimum bending radius for the cable type used in a specific case. Preferably, the sidebars are mounted to the face parts in a dismountable manner to enable them to be replaced or their mounting height to be changed. By this measure, the modular junction units can be adapted so as to ensure the minimum bending angle requirement even if they are already mounted, for example when additional detector rows are installed or existing detector rows are moved to different mounting positions.

In some embodiments the portal formed by the face parts is not closed at the bottom, i.e. has no horizontal bottom bar, but only two posts which rest on the base floor. The cable junction unit can then be installed above an already existing cable bunch. This is advantageous when an already existing computer room installation is extended. In other embodiments the portal is closed at the bottom, i.e. the face parts have a horizontal bottom bar. These embodiments are used when the junction units are installed prior to the laying of the permanent cables.

In some preferred embodiments the junction unit's height and/or width (e.g. the length of the sidebars) is variable which enables it to be adapted to different raised-floor heights and different floor module dimensions.

The described embodiments not only disclose underfloor cable junction units, but also a computer center having a raised floor on which computers are arranged. The volume under the raised floor is equipped with preferred underfloor

cables junction units as described above. The computers are connected to permanent data cables running under the raised floor by means of the junction units. The preferred embodiment of the computer center further comprises active network elements and network element junction units. The permanent data cables permanently connect the underfloor cable junction units and the network element junction units. Patch cables for the connection of the computers to the underfloor cable junction units (also called "first patch cables") as well as patch cables for the connection of the active network elements to the network element junction units (also called "second patch cables") are provided.

Returning now to Fig. 1, it illustrates a preferred embodiment of an underfloor cable junction unit 31 used in a computer room 32 with a raised-floor system in which the floor panels are shown to be transparent. On a base floor 1, floor columns 2 support floor panels 3 which together form a raised floor 4. The raised-floor system is a modular system in which the floor panels 3 are typically in the form of squares, for example with the dimension of 60 cm x 60 cm, which rest on a square frame which in turn rests on the floor columns 2 arranged at the square corners. The height of the raised floor is typically 50 cm to 70 cm, but there are also installations of only about 30 cm. Computers 5 (only two of them are shown in Fig. 1) are placed on the raised floor 4.

Whereas the basic type of floor panel 3 has a completely closed surface, there are special floor panels 3a with cooling air outlets 6 and floor panels 3b with a cable aperture 7. Cooling air 8 flows in the volume under the raised floor 4 in a certain direction (from right to left in Fig. 1), and at each floor panel 3a some of the cooling air is branched off upwardly, flows through the cooling air outlets 6 and is partly sucked in by the nearby computers 5. Although in Fig. 1 only one floor panel 3a with cooling air outlets 6 beneath the module with the cable junction unit 31 is shown, in real applications a larger fraction of such floor panels 3a will be used, and in particular, floor panels 3a with cooling air outlets are also disposed directly above cable junction units 31.

The room under the raised floor 4 also accommodates the cabling of the computer room 32. For example, in Fig. 1 bunches 9 of data cables run from a data communication room (not shown in Fig. 1) on the left-hand side of Fig. 1 on

the base floor 1 from the left to the right in Fig. 1 (only one cable bunch 9 is shown in Fig. 1). The cable bunches 9 comprise individual data cables 10 or bundles 11 of data cables.

A plurality of underfloor cable junction units 31 are arranged throughout the computer room 32 under the raised floor 4, one of which is illustrated in Fig. 1. The cable junction unit 31 is a cube-like dimensioned open frame mounted directly on the base floor 1. It encompasses and thereby guides the cable bunch 9 so that cable trays or the like usually required in prior art installations as shown in Fig. 8 can be omitted. On each of the two faces 33 of the junction unit 31 there are rows 47 of connectors (or ports) 48 on three levels, one above the other. Since, for example, one row 47 has twenty-four connectors 48 only sixteen are shown in the figures, the total number of connectors 48 of the exemplary embodiment shown in Figs. 1 to 4 is higher by a factor nine compared to the prior art junction unit illustrated in Fig. 8. Due to the arrangement of the connectors 48 on the faces 33 of the junction unit 31, they are easily accessible from the floor module adjacent to the direction of the cable bunch 9, in spite of the high port density.

The cable junction unit 31 is equipped with rows 47 of copper cable connectors 48a (e.g. RJ45 connectors) and optical fiber connectors 486 (e.g. E2000 connectors) in a mixed manner. The optical cables used are pre-fabricated break-out cables with pre-installed cable connectors. The junction unit has therefore no splice box.

Open slits 36 are provided in the faces 33 of the junction unit 31 between the connector rows 47. These slits 36, together with the lower open part which enables the cable bunch 9 to pass through the junction unit 31, ensure that cooling air can pass through the junction unit 31 from face 33 to face 33, without significant constriction. Since the junction unit 31 is open at its top 37, a sufficient amount of cooling air is branched off upwardly, when a floor panel 3a with cooling air outlets 6 is disposed directly above the junction unit 31.

As shown in Fig. 1, the bundles of permanent data cables 12 which are permanently connected to the connectors 48 are branched off from the cable bunch 9 under the junction unit 31 and run upwardly at its lateral sides between the two faces 35 of the junction unit 31, where they are fixed to one or more

sidebars 35. Above the sidebar 35 appropriate for the level or the connector row 47 to be connected, they are bent inwardly to reach the rear sides of the respective connectors 48.

The cabling described so far, is permanent, i.e. it is not changed when the configuration of computers 5 to be connected is changed. Rather, the part of the cabling which is adaptable to a particular computer configuration is constituted by the patch cables 19 with suitable cable connectors 20 and both ends. The (typically flexible) patch cables 19 connect the connectors 48 with computer ports 21. They are plugged in the connectors 48 of the junction unit 31 from the outside and run downwardly on the lateral edges of the faces 33 to the base floor 1, and on the base floor 1 towards the computer 5 to be connected, run upwardly and pass through the cable aperture 7 next to the computer 5 to be connected, and then run on the raised floor 4 to the computer 5.

Figs. 2 to 4 show in more detail side, front and top views of the underfloor cable junction unit 31 of Fig. 1. Also shown in Figs. 2 to 4 are the surrounding parts of the raised-floor structure. The top view of Fig. 4 illustrates what is seen from above if the floor panel 3 over the cable junction unit 31 is removed.

The cable junction unit 31 is made up of face parts 34, sidebars 35 and slide-in units 38. The face part 34 is portal-like and has an upper horizontal bar 39, two vertical lateral bars 40 and lower horizontal projections 41 (the terms "horizontal" and "vertical" refer to the normal installation position of the junction unit 31). The horizontal projections 41 each have a mounting hole 42 (preferably an elongated hole) and a grounding pin 43. In other preferred embodiments a horizontal bottom bar 41a (Fig. 6) connecting the two lateral bars 40 is provided instead of the two horizontal bars 41. Since the portal is then closed, its stability is improved. These embodiments with closed portal are used when the junction unit is installed on the base floor 1 prior to the laying of the cable bunches 9.

The vertical lateral bar 40 has a vertical row of threaded holes 44 at its face and, at right angles, another vertical row of threaded holes 45 at its lateral side. Slide-in units 38 and patch cable guiding elements 46 can be fixed to the face part 34 at variable levels by means of screws 49 using one or more of the threaded holes 44 on the appropriate level. Similarly, the sidebars 35 can be fixed

to two face parts 34 on a desired level by means of screws 50 in one or more of the threaded holes 45. The cable guiding elements 46 resemble a fork, the outer end of which is partly closed. The threaded holes 44, 45 are arranged at equal spaces between adjacent holes. This defines a discrete height raster and enables the slide-in units 38 and sidebars 35 to be easily mounted horizontally and in predefined heights.

In other preferred embodiments (not shown) continuously lockable clamps can be provided for mounting the slide-in units 38, the cable guiding elements 46 and/or the sidebars 35 instead of the above-described screw and threaded-hole arrangement.

The sidebars 35 are equipped with holes 51 at their ends to enable them to be mounted laterally to two opposing face parts 34 by means of screws 50 and threaded holes 45, as described above. The upper and lower edges of the sidebars 35 have a comb-like shape with upwardly and downwardly extending tines 50.

The slide-in units 38 include the rows 47 of connectors 48. They are standard units, preferably with a width of nineteen inches. Each slide-in unit 38 has twenty-four RJ45 or E2000 connectors (in the figures only sixteen connectors are shown). The slide-in units 38 are provided with enclosures 53 which protect the interior of the connectors 48. Slide-in units 38 with optical connectors preferably have feed-through connectors of the E2000 system. Optionally, the slide-in units 38 can be equipped with lateral cable guides 57 in the form of downwardly curved troughs (Fig. 5) which are an additional means besides the sidebars 35 of ensuring that the bending radius does not fall below the required minimum value. This is particularly advantageous for slide-in units with optical connectors. Since the cable guides 57 stand over laterally, a slide-in unit 38 with already mounted cable guides 57 has to be tilted to enable the slide-in unit 38 to be slid into or pulled out of the junction unit 31. Alternatively, the cable guides 57 are mounted to the slide-in units 38 before they are slid into the junction unit 31. The slide-in units 38 are equipped with holes 54 near their lateral edges to enable them to be mounted at the faces 33 of the cable junction unit 31 by means of the screws 49 in the threaded holes 44 on an appropriate level.

In order to assemble the cable junction unit 31 from the above-described pieces, two or more sidebars 35 are mounted to each side of two opposing face parts 34 (for installations with a low-raised floor, only one sidebar per side may be sufficient). The resulting frame is a tube-shaped open frame. The height at which the sidebars 35 are mounted depends on the height at which the slide-in units 38 are mounted and which type of data cable is used. The height is to be chosen appropriately so that the data cables to be fixed to the sidebars 35 are not bent beyond the required minimum bending radius. The required number and type of slide-in units 38 are slid into the portal-like opening of the face parts 34 from the outside and secured by means of the screws 49 in the holes 44. This is done in such a manner that slits 36 remain free between the units 38. In the example shown in Figs. 2 to 4 five units 38 with copper cable connectors 48a and one unit 38 with optical connectors 48b has been mounted.

The assembled junction unit 31 is then fixed to the base floor 1 using the mounting holes 42. The unit 31 is dimensioned such that it can be lowered through a module opening of an already installed raised-floor system. Since the embodiment shown in Figs. 2 to 4 has no horizontal bottom bar, it can be installed above an already existing cable bunch 9. However, if the cables are only laid after the installation of the junction unit 31, another embodiment with such a horizontal bottom bar is preferred.

The bundles of permanent data cables 12 which are to be connected to the connectors 48 of the junction unit 31 are branched off from the cable bunch 9 running through the junction unit 31 between the face parts 34. They run upwardly at the junction unit's lateral sides, where they are fixed to the sidebars 35 with cable ties 54. Above the appropriate sidebar 35 they are bent inwardly to the rear side of the connectors 48 to which they are permanently connected. If an optical break-out cable is used, it is fixed in such a manner that the bundle cable (denoted with "12a" in Fig. 3) as a whole is fixed to the sidebar 35, and the point where the bundle cable 12a is split up into individual optical fiber cables (denoted with 10a in Fig. 3) is above the corresponding sidebar 35.

The patch cables 19 are plugged into the connectors 48 and are inserted into the lateral cable guiding elements 46 so that they first run nearly horizontally

from the connectors 48 to the sides of the junction unit 31 and, from there downwardly, guided by the cable guiding elements 46 to the base floor 1, thereby maintaining free access to the lower connector rows 47. The cable guiding elements 46 ensure that the patch cables 19 run in an ordered manner, so that the connectors 48 of the different rows 47 remain accessible and the air flow resistance of the cabled junction unit 31 is not much increased by the patch cables 19. The also function as a traction relief; i.e. a patch cable 19 can not be unplugged by pulling on it from the computer connector end.

The cable junction unit 31 can be used in a flexible way: different types of connector can be used in one and the same junction unit 31. The number of connectors 48 can be varied within certain limits (in special circumstances, it is even possible to fill the slits 36 with additional slide-in units 38); in an already installed junction unit 31 the number and type of connector can be changed; the junction unit 31 can be installed in existing installations with a plurality of cables already running on the base floor; by using shorter or longer sidebars 35 the junction unit 31 can be, within certain limits, adapted to differently sized floor modules.

Fig. 6 illustrates another embodiment which adjustable height and width. The height adjustability is achieved by a telescopic design of the vertical lateral bars, the two telescopic parts are denoted with 40a and 40b in Fig 6. Similarly, the width adjustability is achieved by a telescopic design of the sidebars, the two telescopic parts are denoted with 35a and 35b in Fig 6. A desired height and width can, for example, be secured by screws 49 and 50a. It is clear that embodiments with either height adjustability without width adjustability or width adjustability without height adjustability are also useful, depending on particular needs. The above and following description of technical features of the junction unit 31 and the computer room 32 also applies to such embodiments with adjustable height and or width.

Fig. 7 is a schematic top view of a computer center equipped with underfloor cable junction units 31 as shown in Figs. 1 to 4. The computer center comprises a computer room 32 and a data communication room 55. The computer room 32 houses a plurality of computers 5, whereas the data

communication room 55 houses active network elements 56, such as routers, switches etc. to which the computers 5 are connected. The major part of the length of these connections is provided by the permanently installed data cables 10 (or bunches 9 of such cables) which permanently link network element junction units 57 located in the data communication room 55 with a plurality of (the above-described) underfloor cable junctions 31 which are distributed throughout the computer room 32 under the raised floor 4 (six such junction units 31 are depicted in Fig. 5). First patch cables 19 connect the computers 5 with nearby underfloor cable junction units 31, and second patch cables 56 provide connections between the computers 5 and the respective active network elements 56, as required for a particular configuration of computers 5 and active network elements 56. If the configuration changes, which is often the case in a computer center, only the first and/or second patch cable connections have to be changed.

With the preferred embodiments, a high port density can be achieved which enables a computer center to be equipped with a higher density of computers. Despite the high port density, the forming of hot spots above the cable junction units is avoided. Due to their elaborate, but at the same time simple and modular design, the costs for manufacturing and installing the preferred embodiments and for laying the permanent and patch cables are considerably lower than for prior art designs.

All publications and existing systems mentioned in this specification are herein incorporated by reference.

Although certain methods and products constructed in accordance with the teachings of the invention have been described herein, the scope of coverage of this patent is not limited thereto. On the contrary, this patent covers all embodiments of the teachings of the invention fairly falling within the scope of the appending claims either literally or under the doctrine of equivalence.

What is claimed is:

1. An underfloor cable junction unit for installation in a raised-floor system, comprising rows of connectors, wherein said connector rows are arranged on at least two levels one above the other.

2. The underfloor cable junction unit of claim 1, which is designed to be mounted on a base floor on which the raised floor is posted.

3. The underfloor cable junction unit of claim 1 or 2, which is dimensioned such that it can be lowered through a module opening which is present when a module panel of a discrete modular raised-floor system is removed.

4. The underfloor cable junction unit of any one of claims 1 to 3, wherein rows of connectors are arranged at two opposing faces of the junction unit.

5. The underfloor cable junction unit of any one of claims 1 to 4, wherein the connectors are arranged such that permanent cable connections are provided at the inner side of the connectors facing the inside of the junction unit and plug-in patch cable connections are provided at the outward-facing side of the connectors.

6. The underfloor cable junction unit of any one of claims 1 to 5, wherein the connector rows are at least one of copper data cable connector rows or optical fiber connector rows.

7. The underfloor cable junction unit of claim 6, the optical fiber connectors of which are of a connector type which enables pre-fabricated optical break-out cables with pre-installed cable connectors to be plugged-in at the permanent-cable connection side of the junction unit connectors, without using a splice box.

8. The underfloor cable junction unit of any one of claims 2 to 7, further comprising at least one horizontal sidebar arranged at the lateral sides of the junction unit, wherein the sidebar enables permanent cables coming from the inner side of connector rows to pass above and outwardly of the sidebar downwardly to the base floor and to be fixed to the sidebar.

9. The underfloor cable junction unit of any one of claims 5 to 8, further comprising patch cable guiding elements arranged laterally on at least one of the faces of the junction unit, said guiding elements enabling patch cables plugged into the junction unit connectors to be guided laterally on the face of the junction unit downwardly to the base floor.

10. The underfloor cable junction unit of any one of claims 1 to 9, wherein both faces of the junction unit are open at least at their lower parts to enable bunches of permanent cables to pass through the junction unit, whereby the permanent cable bunches are encompassed and thereby guided.

11. The underfloor cable junction unit of any one of claims 1 to 10, wherein open slits are provided in the face of the junction unit between the rows of connectors, so as to facilitate the passage of cooling air through the junction unit from face to face.

12. The underfloor cable junction unit of any one of claims 1 to 11, having a top side, wherein the top side or at least a major part of it is open to enable the passage of cooling air through the top side.

13. The underfloor cable junction unit of any one of claims 1 to 12, wherein the lateral sides of the junction unit or at least a major part of them are open.

14. The underfloor cable junction unit of any one of claims 1 to 13, wherein the connectors of the connector rows are provided with enclosures.

15. The underfloor cable junction unit of any one of claims 1 to 14, wherein each of the rows of connectors is constituted by a slide-in unit which can be slid into the junction unit at its faces from the outside.

16. The underfloor cable junction unit of claim 15, wherein the slide-in units are fixed to the junction unit in a dismountable manner to enable them to be removed, replaced or changed in their position or enable further slide-in units to be mounted, without dismounting the junction unit.

17. The underfloor cable junction unit of any one of claims 1 to 15, which has a frame structure, the frame comprising portal-like face parts and sidebars connecting the face parts, such that the face parts are arranged opposite each other.

18. The underfloor cable junction unit of claim 17, wherein several mounting positions are provided for the sidebars to enable them to be mounted at different heights.

19. The underfloor cable junction unit of claim 17 or 18, wherein the sidebars are mounted to the front parts in a dismountable manner to enable them to be replaced or their mounting height to be changed.

20. The underfloor cable junction unit of any one of claims 1 to 19 which is height adjustable.

21. The underfloor cable junction unit of any one of claims 1 to 20 which is width adjustable.

22. A computer center having a raised floor on which computers are arranged, said raised floor is equipped with underfloor cable junction units by which the computers are connected to permanent data cables running under the

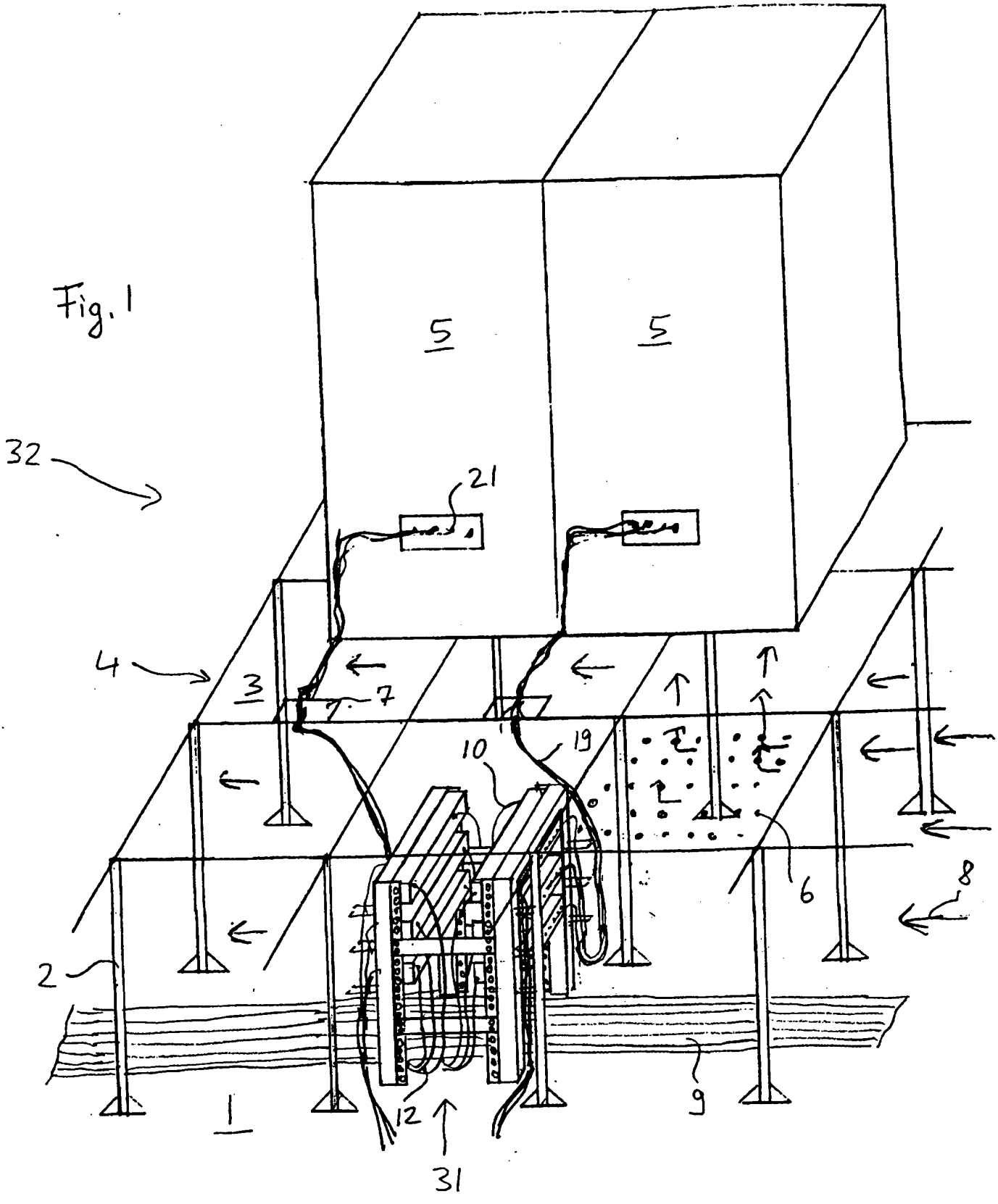
raised floor, said junction unit comprises rows of connectors, wherein said rows are arranged on at least two levels one above the other.

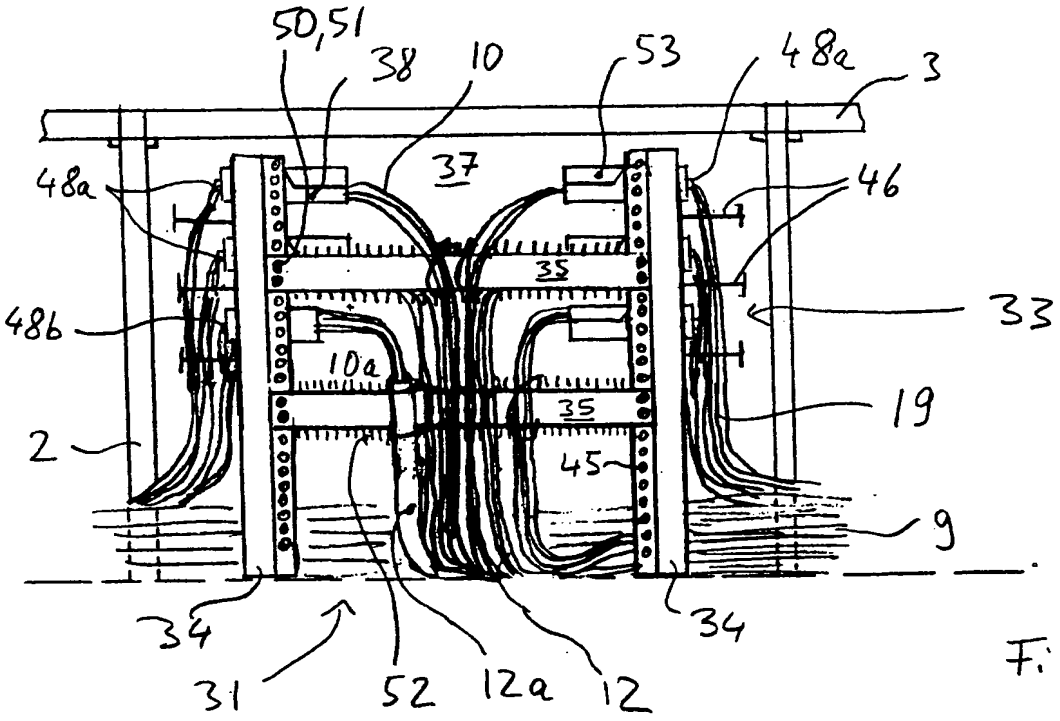
23. The computer center of claim 22, further comprising active network elements and network element junction units, wherein the permanent data cables permanently connect the underfloor cable junction units and the network element junction units, wherein first patch cables for the connection of the computers with the underfloor cable junction units and second patch cables for the connection of the active network elements with the network element junction units are provided.

ABSTRACT

The invention is directed to an underfloor cable junction unit for installation in a raised-floor system, comprising rows of connectors, wherein said connector rows are arranged on at least two levels one above the other. The invention is also directed to a computer center having a raised floor on which computers are arranged, said raised floor is equipped with underfloor cable junction units by which the computers are connected to permanent data cables running under the raised floor, said junction unit comprises rows of connectors, wherein said rows are arranged on at least two levels one above the other.

Fig. 1

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12a
12

Fig. 2

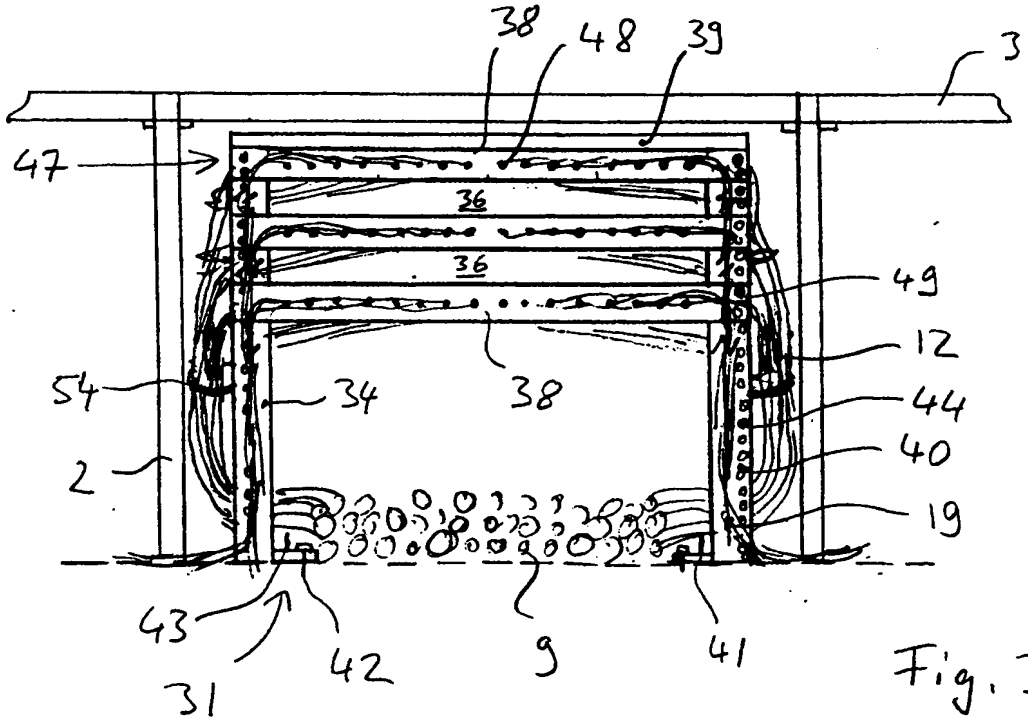
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Fig. 3

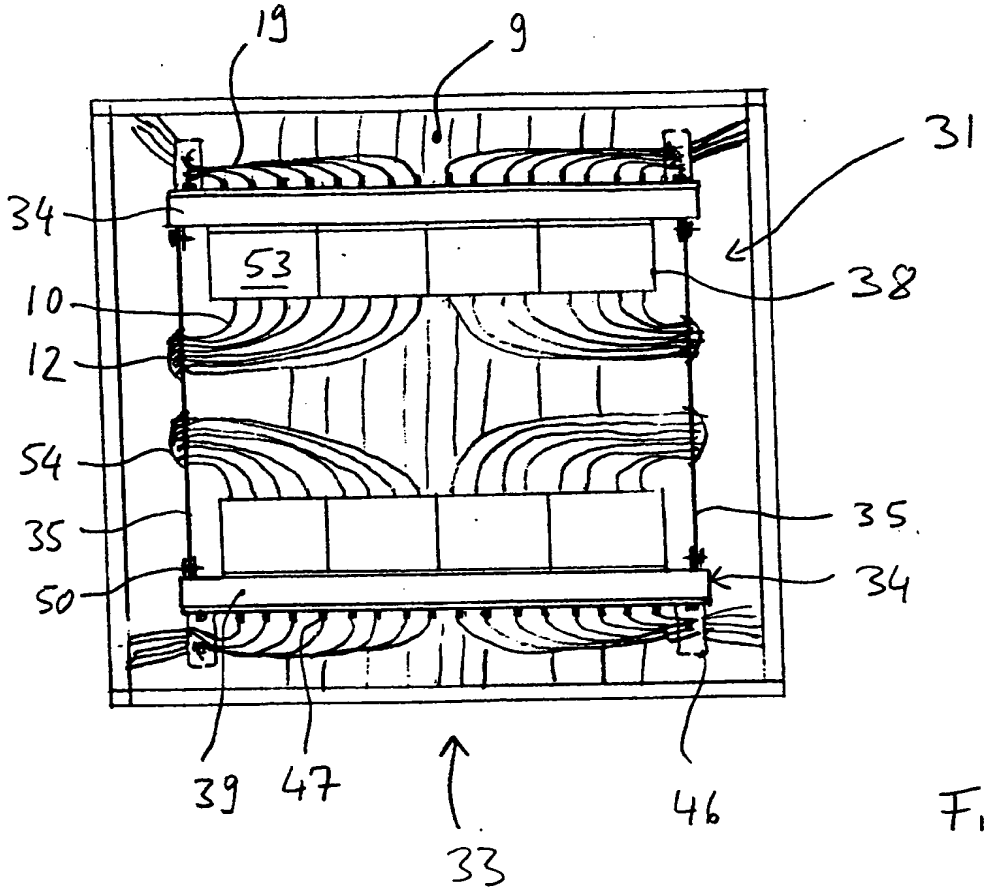

Fig. 4

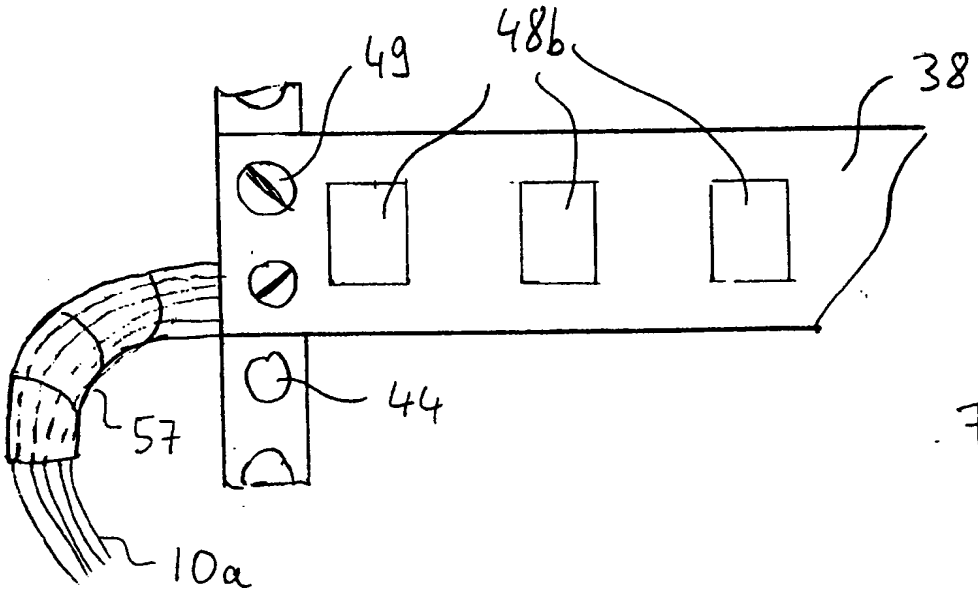

Fig. 5

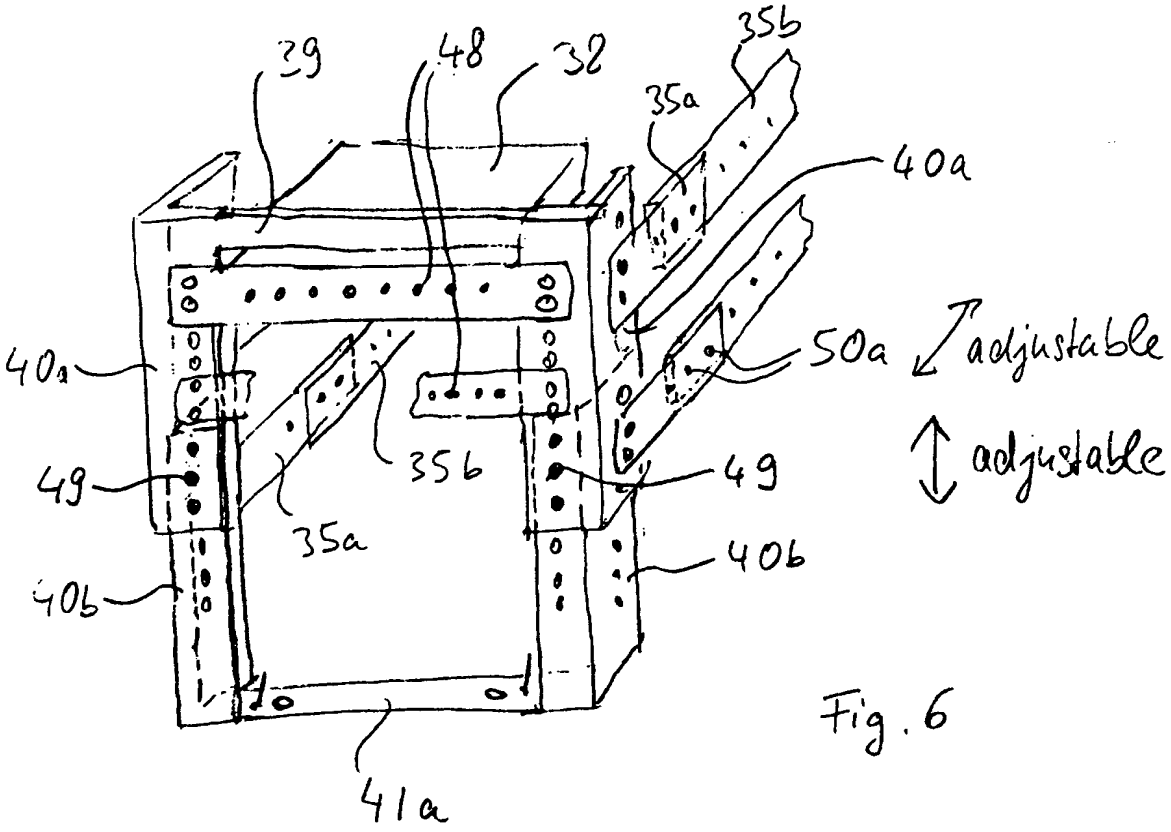
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Fig. 6

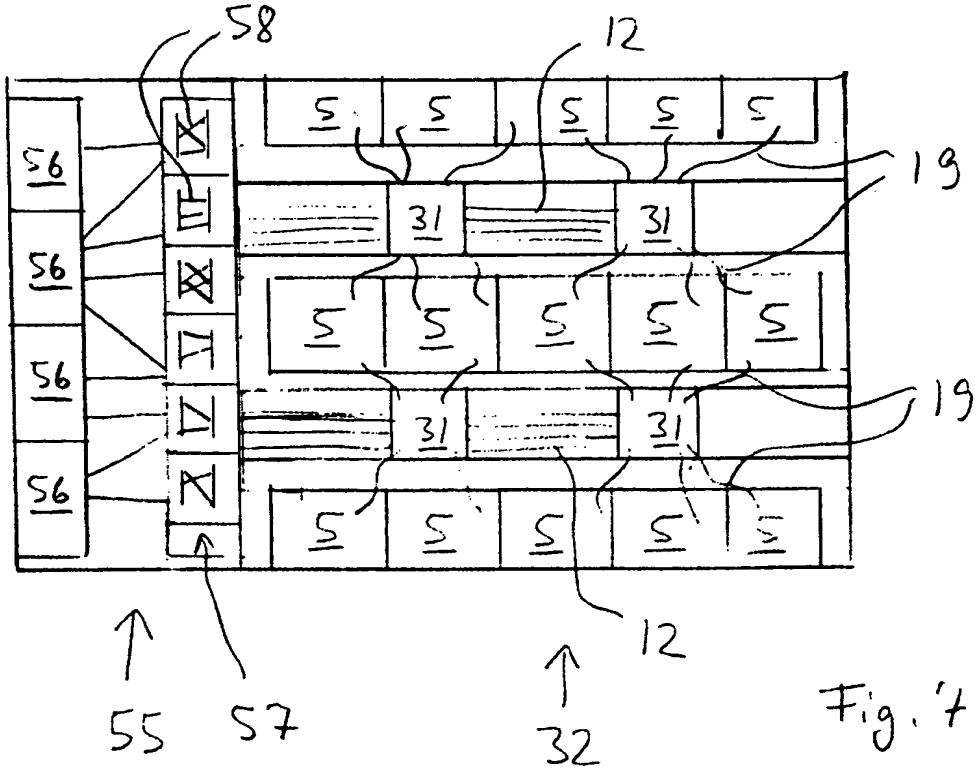
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Fig. 7

Fig. 8
(Prior art)